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25X1A

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SOURCE

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Metals

1. Tungsten

a. Pure tungsten with an insignificant addition to prevent recrystallization (I believe it was Al_2O_3) was used in the form of wires and rods. Wires were used as heaters for receiver tubes and for directly heated cathodes of transmitter tubes.

25X1A

Wire of the following diameters was used for heaters: 0.04 mm. in diameter was for "U" type tubes; 0.085 mm. was used, among others, for the ECH 21 type; 0.122 mm. for the EBL 21 or EBL 1; 0.24 mm. for the EL 150. Wires with a diameter from 0.1 mm.

25X1A

to 1 mm. were used for directly heated cathodes of transmitter tubes. Rods were used for directly heated cathodes of some transmitter tubes.

25X1A

The rods were of various diameters from one millimeter to four millimeter. Until 1948 the rods were also used as input leads through the tungsten glass. Wires were also used for electric bulbs. As of the summer of 1953, the PM Standards (Standards for Vacuum Technique)

were published for wires used as heaters only. Material specifications for tungsten wires and rods for directly heated cathodes of transmitter tubes were established as enterprise standards only in the Tesla Vrosovice Plant in 1952.

b. Tungsten-thorium wire contained from one per cent to two per cent thorium. This wire was used for cathodes with a higher emission,

25X1A

for instance, for the 200/3.5, RHT 1/2, T 329 T, 4-200, and 4-400 tubes. There were various diameters of this kind of wire, from 0.1 mm. to 1 mm. but rarely as large as 1.5 mm. All the tungsten material used in production of vacuum tubes was imported from

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abroad; until 1948 mainly from Philips, the Netherlands; after 1948 most came from Hungary but some was imported illegally from the West. During 1951 and 1952 I heard on several occasions from the chief purchasing official of the Tesla Vrosovice Plant that tungsten and molybdenum were imported from the West as black market goods. [redacted] the exact origin of the goods because they were allotted to the plant by a central distributing office (I do not know which one). Tungsten from Holland was of the best quality, followed by Hungarian tungsten. Black market tungsten was very often of poor quality, but there was no way to return the black market material. 25X1

2. Molybdenum

Pure molybdenum was used in the form of wires, rods, bands, sheets, and foil. Molybdenum wires of the following diameters, 0.04, 0.06, 0.08, and 0.125 mm., were used as winding wires for grids of receiver tubes. They were soft, medium hard, or hard. Wires of 0.2 mm. in diameter were used as centers for tungsten spiral heaters. [redacted] Wires from 0.1 mm. to 1 mm. in diameter were used as winding wires of grids for transmitter tubes of various types, and as supporters for heaters for electric bulbs. Rods in diameters from one to six millimeters were used as supporting rods for grids of transmitter tubes and as supporting rods for cathodes of transmitter tubes. Molybdenum bands from 0.5 mm. to 2 mm. thick and from 2 mm. to 10 mm. wide were used as supporting and connecting parts for grids and cathodes of transmitter tubes. Molybdenum sheets from 0.2 mm. to 2 mm. thick were used mainly as anodes or screens for transmitter and special tubes. Thin sheets, 0.05 mm. thick, were used for sunlamps. [redacted] These molybdenum products were imported from Philips, the Netherlands, and Reuthe, Austria, until 1948. Wires from 0.04 mm. to 0.125 mm. in diameter formed the bulk of imports from the latter firm; these imports continued after 1948. After 1948, molybdenum products reached Czechoslovakia illegally. (See paragraph 1, above).

25X1A 25X1A 25X1A

3. Nickel Tubing

This material was used for cathodes of receiver tubes (the nickel tubing was covered with an emission layer of BaO-SrO alloy), which was about two-thirds nickel and the remainder cobalt, sometimes with an aluminum addition according to some German, and the new Czechoslovak specifications. (The aluminum increased the resistance of the cathode against the heating strain.) The tubing was of the following diameters: 1.3, 1.85, 2.00, 2.5, 3.00 and 4.00 mm. The thickness was from 0.1 to 0.2 mm. The tolerance of the diameter was ± 0.01 mm. and was determined by weighing the material. Nickel tubing was imported from Philips, the Netherlands, and from England until 1948. I think that the imports from England continued after 1948.

4. CrFe Wires and Sheets

This material was 25% chromium and 75% iron. It had approximately the same coefficient of expansion as lead glass and therefore was used for sealing to this glass. This material had good resistance against heat and its qualities were constant. The wire was used as input leads. The diameters of the wire were 1 mm. for miniatures and 1.25 mm. for all-glass tubes. Sheets were from one to two millimeters thick and were used as input parts into glass for low-voltage mercury rectifiers. An NT Standard was established for wires (I believe it was NT Z035); no NT Standards were established for sheets. [redacted] This material was supplied by Philips, the Netherlands, and from Sweden until 1948. After 1948 it came from Czechoslovakia from the United Steel Works, National Enterprise, in Chomutov /N 15-27, E 13-26/.

25X1A

5. NiFe Sheets

These sheets were 50% nickel, 48% iron and 2% manganese, I believe, or perhaps chromium. Sheets were from one to two millimeter thick and were sealed to the lead glass in high-power transmitter tubes. They were imported from Sweden and from Germany (probably Western Germany). Czechoslovak production started in 1952; I do not know at which enterprise but I believe it was United Steel Works, National Enterprise, in Kladno. Some of the Czechoslovak sheets were good but some were not sufficiently malleable.

6. NiFeCu Wire:

This wire had an NiFe core to which a Cu cover was soldered with a thin layer of brass. The wire was used as input leads into lead glass. The diameter was 0.35 mm. for receiver tubes with supporting base. That wire with a diameter of 0.5 to 1 mm. was used for low-current special tubes. Electric bulb factories used this wire in diameters of 0.35 mm. or less. to a minimum of 0.200 mm. Until 1948, this wire was supplied by Philips , the Netherlands, and from other countries in the West, probably for the most part from England. The Czechoslovak trial production of the NiFeCu wire started in 1948 and later became large enough to meet all the Czechoslovak needs. The Czechoslovak wire was, until the end of 1950, inferior to the imported wire. The main reason was that the copper covering was not of a consistent thickness throughout. From 1951, however, the Czechoslovak product was as good as the imported. I do not know which factory was engaged in this production, but it was probably one in Celakovice /N 50-10, E 14-46/; I do not know the name.

7. NiCu Wire

The core of this wire was nickel and the cover was copper. This wire was 0.6 mm. and 0.75 mm. in diameter. It was used as supporting wire for the first grid of receiver tubes. After 1949, however, it was replaced by a wire of Cu with 2% Ag. NiCu wire was imported exclusively from Philips, the Netherlands.

8. FeCu Wire

This wire was of the same size and was used for the same purpose as was the NiCu wire mentioned above; it also came from Philips. The FeCu wire was used during World War II and for a short time afterward.

9. CuNi Wire

The core of this wire was copper; it had a covering of nickel. The wire was 0.6, 0.75, or 1 mm. in diameter and was used as supporting wire for the first grid of those receiver tubes in which winding wires of the grid were welded to the supporting wires. Such tubes were produced in small series, mainly in the former Tesla-Holesovice Plant. This wire could be replaced by Cu plus two per cent Ag wire when the production of grids was fully automatic and where the winding wire was pressed into notches cut into the supporting wires. The CuNi wire was imported from the West, I believe West Germany. Czechoslovak production specifications existed but there was no mass production of this wire in Czechoslovakia.

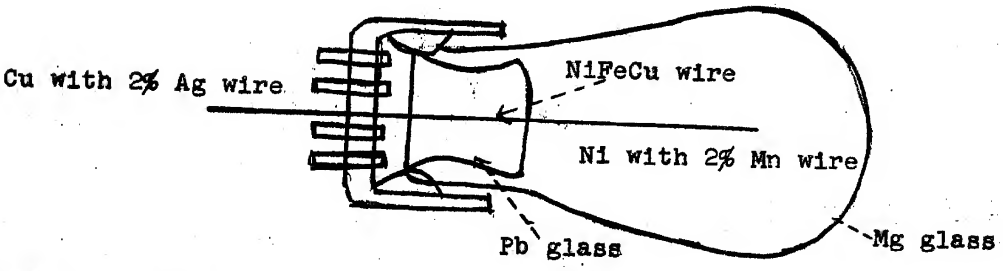
10. Cu with two per cent Ag Wire

The diameter was 0.6 and 0.75 mm. This wire was soft and was used for supporting wire for first grids of receiver tubes; after 1948 this wire was the main one used for that purpose, and the other wires mentioned above were used less frequently. This wire was also used

as an input lead for receiver tubes with supporting base. Until 1948, the Cu with two per cent Ag wire was imported from Philips, the Netherlands. Production in Czechoslovakia started shortly after 1945 in the Celakovice Factory, which became the main supplier of this wire after 1948. In the beginning the Czechoslovak product was of a poor quality because the copper was not pure. This copper, which was imported, was foundry copper and not electrolytic copper, as it should have been. This failure was corrected later on; I do not know how.

11. Ni with two per cent Mn Wire

This wire was 0.6, 0.8, 1 and 1.5 mm. in diameter. When soft, it was used as a supporting wire for the second, third and, eventually, the fourth grid of receiver tubes. When hard, it was used for production of input leads for receiver tubes with supporting base. When medium hard it was used for connecting various parts of receiver tubes. Until 1948 the wire was imported from Philips, Eindhoven. The Czechoslovak production started after 1945 in the Celakovice Factory which became almost the exclusive supplier of this item after 1948.



This sketch shows a typical input wire before it is attached to the elements inside and to the base pin.

12. Ni with five per cent Mn Wire

This wire was hard and 0.125 mm. in diameter. It was used as winding wire for the third grid of various tubes such as EBL 1, AL 4, and others. In fact, it was a substitute for molybdenum wire. Until 1949 it was imported from Philips, Eindhoven; after 1948 it was supplied by the Celakovice Factory.

13. Nickel (high purity) for directly heated cathodes

a. Wire: From 0.1 to 0.5 mm. in diameter, used as winding wire around tungsten cathodes (cathodes were tungsten spirals) of low-voltage mercury rectifiers, for example, for DCG 4/1000, T 367, T 1710, and T 1749 tubes. 25X1A [redacted]

b. Thin and narrow bands: Size 0.8/0.1 mm. Covered with Ba CO_3 — Sr CO_3, used as cathode for AZ 1 tube. Slightly larger was used for AX 50 tube. 25X1A [redacted]

c. Mesh wire (covered with Ba CO_3 — Sr CO_3): Used as cathode for high-voltage mercury rectifiers, for example, GU 14 and GU 11. 25X1A [redacted]

d. Sheets and rods: Sheets were 0.1 to 0.2 mm. thick; rods were from 1 to 10 mm. in diameter. They were used for sunlamps S-200 and S-300 types. 25X1A [redacted]

Nickel for cathodes was imported from Philips, the Netherlands, until 1948. After 1948 the Czechs tried to import this nickel from some other Western countries, such as Great Britain. I do not know the source of supply at the time I left.

14. Nickel sheets

These sheets were pure nickel plus cobalt containing only a small amount of impurities. Medium-hard sheets 0.15 mm. thick were mainly used for anodes and screens for receiver tubes, sheets 0.1, 0.125, and 0.2 mm. thick for small low-power special electronic tubes. Until 1948 this material was imported from Philips, Eindhoven; and there may have been some imported from Great Britain, too. It was also produced in Czechoslovakia, probably in the Celakovice factory prior to 1948. After 1948 it was all of Czechoslovak origin.

15. Carbon-nickel sheet (also called carbonife sheet)

This was iron sheeting plated (by rolling) on both sides with nickel coated with carbon. Most of it was 0.15 mm. thick (0.9 mm. iron plus 0.3 mm. nickel on each side) but some was 0.1 and 0.125 mm. thick. It was produced in pieces 140 mm. wide. Carbon-nickel sheeting was used as a substitute for medium-hard nickel sheeting because it was cheaper. Until 1948 it was imported from Philips, Eindhoven. Czechoslovak trial production started in 1947. In the following years only small quantities were produced; these were used from time to time in electronic tube production. The quality was good, although not as good as the imported, but the price of the Czechoslovak product was too high. Therefore, I believe that this material was still imported from the West after 1948. The only customer for this material was the Tesla-Roznov Plant which used it for anodes and screens for receiver and low-power special electronic tubes. I believe that the Vah Machinery Works produced this material.

16. Iron-nickel plated sheet

This was an iron sheet, plated (by galvanization) with a thin nickel layer on both sides. The iron was degassed and contained very few impurities. The thicknesses used most were 0.15 mm. and 0.125 mm. Iron-nickel plated sheet was used as a substitute for medium-hard nickel sheets and for carbon-nickel sheets /paragraphs 14 and 15/ and it was used for screens or some other less important parts of receiver tubes and of low-power special tubes. However, the use of this material decreased the life of the tubes. This material was produced in Czechoslovakia; I believe by the Vah Machinery Works.

17. P 2 sheet

This was an iron sheet, aluminum plated on both sides. The iron was degassed and contained few impurities. The iron core was 0.9 mm. thick, and was aluminum-plated by spraying. The thickness of the aluminum coat was .03 mm. on each side. The P 2 sheet was used for production of anodes of receiver tubes and it was a good substitute for the medium-hard nickel sheet /paragraph 14/, and for carbon-nickel sheet. Until 1948 this sheet (aluminum plated by rolling) was imported from Philips, the Netherlands. Czechoslovak production of this sheet (plated by spraying) started, I believe, in the Vah Machinery Works in 1947. The Czechoslovak product proved satisfactory, even though the quality was not as good as the Philips product.

18. PN sheet

This was an iron sheet, aluminum-plated on one side only. It was used as a substitute for medium-hard nickel sheet and for carbon-nickel sheet. It was imported from Philips, Eindhoven, until 1948. Czechoslovak production started in 1947, I believe in the Vah Machinery Works, and reached 80% of the quality of the Philips product.

19. OFHC Cu

This was degassed copper, in the form of tubes, plates, rods, and sheets, and was used for transmitter tubes with external anodes; in such tubes it was used mainly for anodes, anode shields, grid rings, and filament terminals, that is, those parts which were to contact the vacuum were made of OFHC Cu. OFHC Cu was imported; the only source was the West, probably Great Britain. The tubes, plates, rods, and sheets were produced, from the material imported, by the Celakovice factory and from this material the parts for electronic tubes were produced in the Tesla Vrsovice plant. In 1952 the Celakovice factory started the production of OFHC Cu; this was the usual electrolytic copper which was alloyed, probably with cadmium. This production was a complete success; the Czechoslovak material almost equalled in quality the material imported.

20. Kovar Metal

This was an alloy of various metals in fixed ratios, but I do not know the details. It was sealed to Kovar glass parts and was used for production of input leads for transmitters, as well as for some high-power special electronic tubes. The Czechoslovak production of this alloy started in 1951 or 1952, but I do not know the name of the factory engaged in this production. The production followed Western methods. All Kovar metal was domestically produced. This material was used for the first time in the Tesla Vrsovice plant at the end of 1952.

21. Ba Fe and Ba Ni wires

This was a nickel or iron tubing filled with barium. The diameters used were 2 mm., 1.5 mm., and 1 mm. The thickness was from 0.2 to 0.1 mm. This wire was used as a getter for receiver tubes and for some special electronic tubes. The material was imported from Philips, Eindhoven, and from other Western suppliers, including Italy. I believe that as of the summer of 1953 there was no Czechoslovak production of this wire.

22. Mg wire

This was a pure magnesium wire. The diameter was 0.4 mm. It was used as a getter for receiver tubes and it was placed on the second grid. Only that wire with a diameter from 0.5 to 1.0 mm. was used as a getter for low-voltage mercury rectifiers, for instance, T 367, T 1710, T 1749 [redacted]. Until 1948 this was supplied by Philips, Eindhoven; after that date I believe it was produced in Czechoslovakia.

25X1A

23. Platinum

Platinum for use in vacuum tubes was in the form of bands, sheets, and input tubings. The bands and sheets were from 0.1 to 0.5 mm. thick and were used as input leads and sealed to the lead glass of MT type tubes [redacted]. The input tubings ([redacted]) were used for medium-power transmitter tubes with external anodes, i.e., the CAT 6, CAT 9 [redacted]. Beginning in 1953 efforts were made to replace these platinum input tubings by a similar Cr Fe material, and the trial production was successful. Platinum materials were supplied by Safina, National Enterprise, a firm in Prague dealing with precious metals.

25X1A

25X1A

24. Silver soldering rods

The composition of these rods was 50% to 80% silver and the remainder copper. They were used for soldering metal parts of transmitter tubes which were in contact with the vacuum. These rods were from one to two millimeter thick and from four to eight millimeter wide. They were supplied by Safina, National Enterprise, in Prague.

25. Tantalum

Tantalum in thin sheets was used for anodes of some special tubes with high temperature anodes. Further, Tesla-Roznov Plant used tantalum in thin sheets in its special department for welding materials that were difficult to join, such as molybdenum with tungsten or molybdenum with molybdenum. This material was left from World War II in the Tesla-Roznov Plant.

26. Mercury

Chemically pure mercury was prepared by the individual enterprises concerned from the technically pure mercury. It was used for filling mercury rectifiers. I do not know the source of supply of this material.

27. Graphite rods and bars

The rods were from 10 to 16 mm. in diameter; the bars were from 8 to 10 mm. thick, 20 to 30 mm. wide. These graphite rods and bars were used as anodes; the bars for the T 1710 and T 1749 tubes, the rods
25X1A of 10 mm. diameter for the T 367 type (all these tubes were produced in the Tesla-Roznov Plant [redacted]) while rods of larger diameters
25X1A were used in the Tesla Vrsovice Plant, mainly for GT 15 tubes (see [redacted]). This material was imported from the West; from Philips, the Netherlands, until 1948; I do not know from which country after 1948.

28. Zircon

In the form of zircon powder (zircon mixed with two to ten per cent zircon oxide) this material was used primarily to cover anodes but also it was sometimes used to cover grids. When the tubes were in operation the zircon coat got warm and acted as a getter. It was used mainly for anodes and grids for high-power transmitter tubes with internal anodes. There was no domestic production of this material; it was imported. The main supplier before 1948 was France. Stocks of zircon at the Tesla Hloubetin Plant were left over from World War
25X1A II. Zircon was very difficult to obtain in Czechoslovakia after 1948 [redacted]. There were efforts made in the laboratory of the Tesla Vrsovice Plant, at the beginning of 1953, to replace zircon
25X1A powder with a mixture of titanium plus titanium oxide. The results were still undetermined as of early summer 1953.

Glass [redacted]

29. Lead glass

Lead glass was sealed to metals such as NiFeCu wire, NiFe wire, NiCr wire, and platinum parts. Lead glass was used in the production of bases and in the production of glass die castings of receiver tubes. It was also used for bases and envelopes for some low-power special tubes and for all-glass parts of high-power transmitter tubes when hard glass was not used. The lead glass was delivered in the form of tubes, rods and envelopes. Tubes (of various diameters from 3 mm. to 30 mm.) as well as envelopes (of various shapes) and very rarely rods (one to five millimeter in diameter) were produced in Czechoslovakia by the Glass Works in Horni Polubny (N 50-46, E 15-20) and at Nizbor, somewhere in the vicinity of Beroun (N 49-54, E 14-05). Glass tubes with a diameter of one millimeter were not produced domestically but were imported from Philips, Eindhoven.

30. Magnesium glass

This glass was used for envelopes of receiver tubes and for electric bulbs. (Philips used calcium glass instead of magnesium glass.) Magnesium glass was produced by the Glass Works at Utekac (N 48-76, E 19-48).

31. Molybdenum glass

This glass was used for transmitter and sealed to molybdenum parts, for high-power special tubes. It was produced in the form of tubes from 4 to 16 mm. in diameter and in the form of envelopes of various shapes. Molybdenum glass was supplied by the Kavalir Glass Works, probably located at Sazava /N 49-52, E 14-547.

32. Tungsten glass

Before 1945, tungsten glass was used in Czechoslovakia for special high-power tubes and in transmitter tubes where it was sealed to the tungsten parts. This glass was of German origin, and was not used in Czechoslovakia after 1945. It was replaced by molybdenum glass because the Czechoslovak glass works could not produce tungsten glass.

33. Kovar glass

Kovar glass was sealed to the Kovar metal parts. It was produced by the Kavalir Glass Works during 1952. Samples of this glass were used
25X1A for the first time in Czechoslovakia at the end of 1952 by the Tesla-Vrsovice Plant for the ATL 2 tubes [redacted]. This glass was not imported.

34. Silicon glass

This glass was produced in the form of tubes (diameter of 20/15 mm. for S-200 sunlamps; diameter 25/19 mm. for the S-300 sunlamp) and
25X1A in prism form (8 mm. diameter for the S-200 and S-300 sunlamps) and in the form of rods of various diameters (from 4 to 10 mm.). Silicon glass was used in the production of sunlamps [redacted] and in various shapes as insulating material for transmitter tubes produced in the Tesla-Vrsovice Plant. All silicon glass was imported until 1948; most of it came from France. After 1948 it was difficult to obtain. During 1952 there were discussions in the Tesla-Roznov Plant concerning the replacement of the imported silicon glass but no steps were taken.

Chemicals

35. $BaCO_3$ (Barium Carbonate)

This material, chemically pure, was used as emissive coating of
25X1A cathodes of some special electronic tubes, i.e., GU 14, GU 11 [redacted]. (The cathodes coated with barium carbonate or with a similar coating were called oxide cathodes.) Until 1948 barium carbonate was supplied by Philips, Eindhoven; after that by the United Chemical Works, but I do not know which plant.

36. $SrCO_3$ (Strontium Carbonate)

This material, chemically pure, was mixed with $BaCO_3$ in a proportion one to one, and used as the emissive coating for cathodes of receiver tubes. Until 1948 $SrCO_3$ was supplied by Philips, the Netherlands. After 1948, by the United Chemical Works (I do not know which plant).
25X1A The imported material was better than the Czechoslovak product [redacted].

37. $Ba(OH)_2$ (Barium Hydroxide)

This material was used as emissive coating for cathodes of small
25X1A low-voltage mercury rectifiers, for instance, P 367, P 1710, P 1749 tubes [redacted]. (The cathodes were immersed in melted $Ba(OH)_2$.) Before 1948 it was supplied by Philips, afterward by the United Chemical Works.

38. Al_2O_3 (Aluminum Oxide)

This material was used as insulating material for heaters of indirectly heated cathodes. Its usual European commercial name was Alundum. It was a chemically pure, fine white powder. Until 1948 it was supplied by Philips, the Netherlands. After 1948 this material was still probably imported. Attempts were made during 1948 to import a similar product from the US but I do not know the results of these efforts

25X1A

39. Graphite suspension

This was a finely ground graphite usually diluted with water. It had several different trade names. It was used for blackening various parts of tubes, for instance, anodes, cooling parts for grids, and to coat the sides of glass envelopes to prevent secondary emission of electrons. Before 1948 most of it was imported from Philips, the Netherlands, although some was produced in the chemical laboratory of the Tesla Hloubetin Plant, and later in the Tesla-Roznov Plant. After 1948 it was not imported

25X1A

40. Fluorescent Material

These materials, of various metal silicates, were used for tuning eyes and as screens of picture tubes. These materials were imported; however, I believe they were also produced in the Tesla-Roznov Plant and in the Institute for Vacuum Technique and Technology of Parts

25X1A

41. Argon

This product, chemically pure and sometimes spectrum pure, was used to fill various special tubes, such as the T 367, T 1710, T 1749, S-200 and S-300 sunlamps, and the GM tubes. Argon was originally imported from Philips, the Netherlands, but later it was furnished by the Ostrava Chemical Works.

25X1A